CLAIMS

WHAT IS CLAIMED IS:

1. A system for generating a signal for communicating with a downhole assembly comprising:

a transmitter for generating said signal in a flow of fluid being directed downhole;

a control system for operating said transmitter without stopping said pumping; and

a downhole receiver for receiving said signal and decoding said signal.

2. The system of claim 1 wherein said downhole receiver comprises a flow meter or a pressure sensor.

3. The system of claim 1 wherein said downhole receiver is a pressure while drilling tool.

4. The system of claim 1 wherein said decoded signal is an instruction to the downhole assembly.

5. The system of claim 1 further comprising a downhole master controller for distributing said decoded signal to a component of said downhole assembly.

6. The system of claim 1 wherein said downhole receiver further comprises:

a scheme for filtering said signal; and

an algorithm for decoding said signal.

7. The system of claim 6 wherein said algorithm interprets one bit of information in a minimum of approximately two seconds.

8. The system of claim 6 wherein said algorithm further performs an error-checking function.

9. The system of claim 1 wherein said transmitter comprises:

a flow control device being moveable between an open position and a closed position; said open position allowing a quantity of said fluid to flow through a bypass line; and

a flow restrictor that sets said quantity.

10. The system of claim 9 wherein said flow restrictor is changeable to adjust said quantity.

11. The system of claim 9 wherein said flow restrictor is disposed in a manifold including a means for changing said flow restrictor to adjust said quantity.

12. The system of claim 9 wherein said flow restrictor is disposed upstream of said flow control device.

13. The system of claim 12 wherein said flow restrictor reflects pressure pulses generated by the flow control device.

14. The system of claim 9 wherein said flow restrictor is a bit jet nozzle having an orifice therethrough.

15. The system of claim 9 wherein said flow restrictor is formed of tungsten carbide.

16. The system of claim 9 wherein said control system moves said flow control device between said open position and said closed position to generate said signal.

17. The system of claim 9 wherein said flow control device further includes an actuator.

18. The system of claim 9 wherein said transmitter further includes:

a flow diverter; and

a backpressure device.

19. The system of claim 18 wherein said flow diverter is disposed between said flow restrictor and said flow control device.

20. The system of claim 18 wherein said flow diverter is shaped to streamline the flow.

21. The system of claim 18 wherein said flow diverter is constructed of materials that minimize wear.

22. The system of claim 18 wherein said backpressure device is located downstream of said flow control device.

23. The system of claim 18 wherein said backpressure device is a bit jet nozzle having an orifice therethrough.

24. The system of claim 1 wherein said transmitter comprises:

a first flow control device having an open position and a closed position; said open position allowing a quantity of said fluid to flow through a first bypass line;

a first flow restrictor that sets said quantity;

a second flow control device having an on and an off position; said on position allowing a percentage of said fluid to flow through a second bypass line when said first flow control device is in the open position; and

a second flow restrictor that sets said percentage.

25. The system of claim 24 wherein said quantity and said percentage may flow through said first and second bypass lines simultaneously.

26. The system of claim 24 wherein said control system operates said first flow control device between said open position and said closed position to generate said signal.

27. The system of claim 24 wherein said first flow control device is a pneumatically operated valve.

28. The system of claim 24 wherein said second flow control device is a valve.

29. The system of claim 24 wherein said second flow control device is operated between the on position and the off position only when the first flow control device is in the closed position.

30. The system of claim 24 wherein said second flow control device further includes a pneumatically controlled actuator and control system that operates the second flow control device between said on position and said off position.

31. The system of claim 1 wherein said control system comprises:

a computer for inputting an instruction; and

a downlink controller for receiving said instruction from said computer and operating said transmitter to generate said signal.

32. The system of claim 31 wherein said computer includes a graphical user interface screen.

33. The system of claim 31 wherein said control system further comprises:

a pneumatic assembly for operating a pneumatic actuator on said transmitter for generating said signal.

34. The system of claim 33 wherein said pneumatic assembly comprises:

a pair of air valves;

a manual override manifold; and

air lines including quick connect fittings.

35. The system of claim 1 wherein said transmitter and said control system are intrinsically safe.

36. A system for generating a signal in a flow of fluid being directed downhole for communicating with a downhole assembly comprising:

means for bypassing a quantity of fluid to generate said signal without stopping the pumping of said fluid;

means for restricting the quantity of fluid being bypassed; and

means for receiving said signal and decoding said signal into said instruction.

37. A system for communicating with a downhole assembly comprising:

a transmitter for generating a signal in a flow of fluid being directed downhole; said transmitter comprising a flow control device and a flow restrictor;

a control system for operating said transmitter without stopping the fluid being pumped downhole; said control system comprising a computer and a downlink controller; and

a downhole receiver for receiving said signal and decoding said signal; said downhole receiver comprising a pressure sensor.

38. A system for sending simultaneous, bi-directional signals between a surface assembly and a downhole assembly comprising:

a pump for continuously pumping a fluid between a surface location and a downhole location;

a bypass line for generating a downlink signal within a first frequency band without stopping said pump; and

a pulser for generating an uplink signal within a second frequency band;

wherein said downlink signal and said uplink signal are generated simultaneously.

39. The system of claim 38 wherein said downlink signal is generated by diverting a portion of said fluid through said bypass line.

40. The system of claim 38 wherein said first frequency band is between five and ten times lower than said second frequency band.

41. A system for communicating with a downhole assembly operating within a well comprising:

a tubular member connected to said downhole assembly; said tubular member disposed internally of said well to create an annular flow area therebetween;

a mud pump in fluid communication with said tubular member; and

a bypass line;

wherein said mud pump continuously pumps a fluid along a flow path into said tubular member, through said annular flow area, and back to said mud pump;

wherein said bypass line diverts a portion of said fluid to create a signal of pressure pulses that travel through said fluid along said flow path; and

wherein said downhole assembly includes a receiver for receiving and decoding said signal.

42. A system for receiving and decoding a pressure pulse signal into an instruction to a downhole assembly comprising:

a receiver for receiving said signal; and

an algorithm for decoding said signal; said decoding comprising:

filtering said signal to generate a filtered signal;

cross-correlating said filtered signal using a template waveform to generate a processed signal;

determining said instruction from said processed signal; and

performing an error check to ensure said instruction was properly determined.

43. A system for receiving and decoding a pressure pulse signal into an instruction to a downhole assembly comprising:

a receiver for receiving said signal; and

an algorithm for decoding said signal; said decoding comprising;

filtering said signal to generate a processed signal; and

determining said instruction from said processed signal.

44. A method for communicating with a subsurface assembly comprising:

introducing a series of pressure pulses into a fluid being pumped into a well without interrupting the pumping;

receiving downhole a signal that includes the series; and

decoding the signal.

45. The method of claim 44 wherein the series of pressure pulses forms an instruction.

46. The method of claim 44 wherein the series of pressure pulses is introduced by bypassing a portion of the fluid being pumped into the well.

47. The method of claim 44 wherein each pulse is one or more seconds in duration.

48. The method of claim 44 wherein the series of pressure pulses is introduced by opening and closing a flow control device.

49. The method of claim 48 wherein opening the flow control device allows a portion of the fluid to flow through a bypass line.

50. The method of claim 49 wherein said portion is adjusted by a flow restrictor.

51. The method of claim 48 wherein opening the flow control device allows a portion of the fluid to flow through a first bypass line and a quantity of the fluid to flow through a second bypass line.

52. The method of claim 51 wherein a valve allows or prevents the quantity from flowing through the second bypass line.

53. The method of claim 44 wherein decoding the signal comprises:

passing the signal through at least one filter to create a processed signal; and

passing the processed signal through an algorithm.

54. The method of claim 53 wherein creating the processed signal comprises creating a filtered signal and cross-correlating the filtered signal with a template waveform.

55. The method of claim 54 wherein creating the filtered signal comprises passing the signal through a median filter and a band pass filter.

56. The method of claim 53 wherein passing the signal through the at least one filter removes noise and the DC component of the signal.

57. The method of claim 54 wherein the template waveform is a bipolar square wave.

58. The method of claim 53 wherein said processed signal comprises samples including a series of peaks with an interval of time provided between each peak.

59. The method of claim 58 wherein each interval comprises a number of bits of information.

60. The method of claim 58 wherein the intervals form an instruction comprising at least one command interval, at least one data interval, and a parity interval.

61. The method of claim 60 wherein the parity interval is for verifying that the instruction was properly received.

62. The method of claim 58 wherein passing the processed signal through an algorithm comprises:

determining each interval in the processed signal;

calculating a value for each interval; and

matching the value for each interval to a table entry.

63. The method of claim 62 further including error checking the calculated values.

64. The method of claim 62 wherein determining each interval comprises:

comparing each sample in the processed signal to a threshold;

determining each peak in the processed signal from the samples that exceed the threshold;

determining a time for each peak; and

calculating the interval between the peak times.

65. A method of achieving simultaneous, bi-directional communication between a surface system and a downhole assembly comprising:

transmitting to the downhole assembly a downlink series of pulses within a first frequency band;

transmitting to the surface system an uplink series of pulses within a second frequency band;

receiving a first signal at the downhole assembly; and

receiving a second signal at the surface system.

66. The method of claim 65 further including:

filtering the uplink series out of the first signal; and

filtering the downlink series out of the second signal.

67. The method of claim 65 wherein the second frequency band is between five and ten times higher than the first frequency band.

68. A method for drilling a borehole comprising:

transmitting to a drilling assembly a series of downlink instruction signals; and

optionally transmitting from the drilling assembly a series of uplink data signals;

wherein said downlink instruction signals and said uplink data signals may be transmitted simultaneously.

69. A method for drilling an accurately located well borehole at a drilling site that is optimized for minimum drag and maximum drilling efficiency comprising:

transmitting to a drilling assembly a series of downlink instruction signals; and

selectively transmitting from the drilling assembly a series of uplink data signals;

wherein said downlink instruction signals and said uplink data signals may be transmitted simultaneously.

70. The method of claim 69 wherein the drilling assembly comprises rotary steerable/directional drilling tools.

71. The method of claim 70 wherein the drilling tools comprise one or more of a rotary steerable tool, a remotely controllable adjustable stabilizer, and a remotely controllable downhole adjustable bend motor.

72. The method of claim 69 further comprising:

monitoring the borehole conditions during drilling; and

adjusting the drilling assembly.

73. The method of claim 72 wherein the monitoring and the adjusting are done continuously.

74. A method for transmitting a computer command to generate downlink instruction signals to control a directional drilling operation at a drilling site wherein the computer command is transmitted from a location remote from the drilling site.

75. The method of claim 74 wherein the location remote from the drilling site is a command center capable of remotely controlling a plurality of directional drilling operations at a plurality of different drilling sites.

76. A method for automatically drilling a well borehole at a drilling site using bi-directional downlink and uplink signaling wherein the computer commands to generate downlink signaling are transmitted either locally from the drilling site or from a location remote from the drilling site.

77. The method of claim 76 wherein a drilling assembly and a surface controller are programmed with a predetermined trajectory for the well borehole and the well borehole is automatically drilled by the drilling assembly.

78. The method of claim 77 wherein the bi-directional signaling is used to maintain the drilling assembly on the predetermined trajectory.

79. A method for sending downlink instruction signals without interrupting drilling to effect an operating change to any of a plurality of downhole tools in a downhole assembly.

80. The method of claim 79 wherein the operating change is turning a tool on or off to reduce the total power consumed by the downhole assembly.

81. The method of claim 79 wherein the operating change is to take a sample using a drilling formation tester.

82. The method of claim 79 wherein the operating change switches a stabilizer between a free rotating and a locked mode.

83. The method of claim 79 wherein the operating change is to change between preprogrammed lookup tables.

84. The method of claim 79 wherein the operating change is to alter parameters of a preprogrammed lookup table.

85. A method for increasing or decreasing the data rate of downlink signaling to communicate an instruction to a downhole assembly utilizing a plurality of preprogrammed lookup tables.

86. The method of claim 85 wherein increasing or decreasing the data rate of downlink signaling comprises switching between preprogrammed lookup tables.

87. The method of claim 85 wherein increasing or decreasing the data rate of downlink signaling comprises communicating an instruction to modify parameters in the preprogrammed lookup tables.

88. The method of claim 85 further comprising increasing or decreasing the data rate of uplink signaling wherein the data rate of downlink signaling can be increased or decreased if the data rate of uplink signaling is increased or decreased.

89. A method for achieving an effective high data rate of downlink signaling to communicate an instruction to a downhole assembly utilizing a plurality of preprogrammed lookup tables.

90. The method of claim 89 wherein the effective high data rate of downlink signaling is achieved by switching between preprogrammed lookup tables.

91. The method of claim 89 wherein the effective high data rate of downlink signaling is achieved by communicating an instruction to modify parameters in the preprogrammed lookup tables.

92. A method of achieving high data rate downlink and uplink signaling wherein the data rate of downlink signaling can be increased when the data rate of uplink signaling is increased.